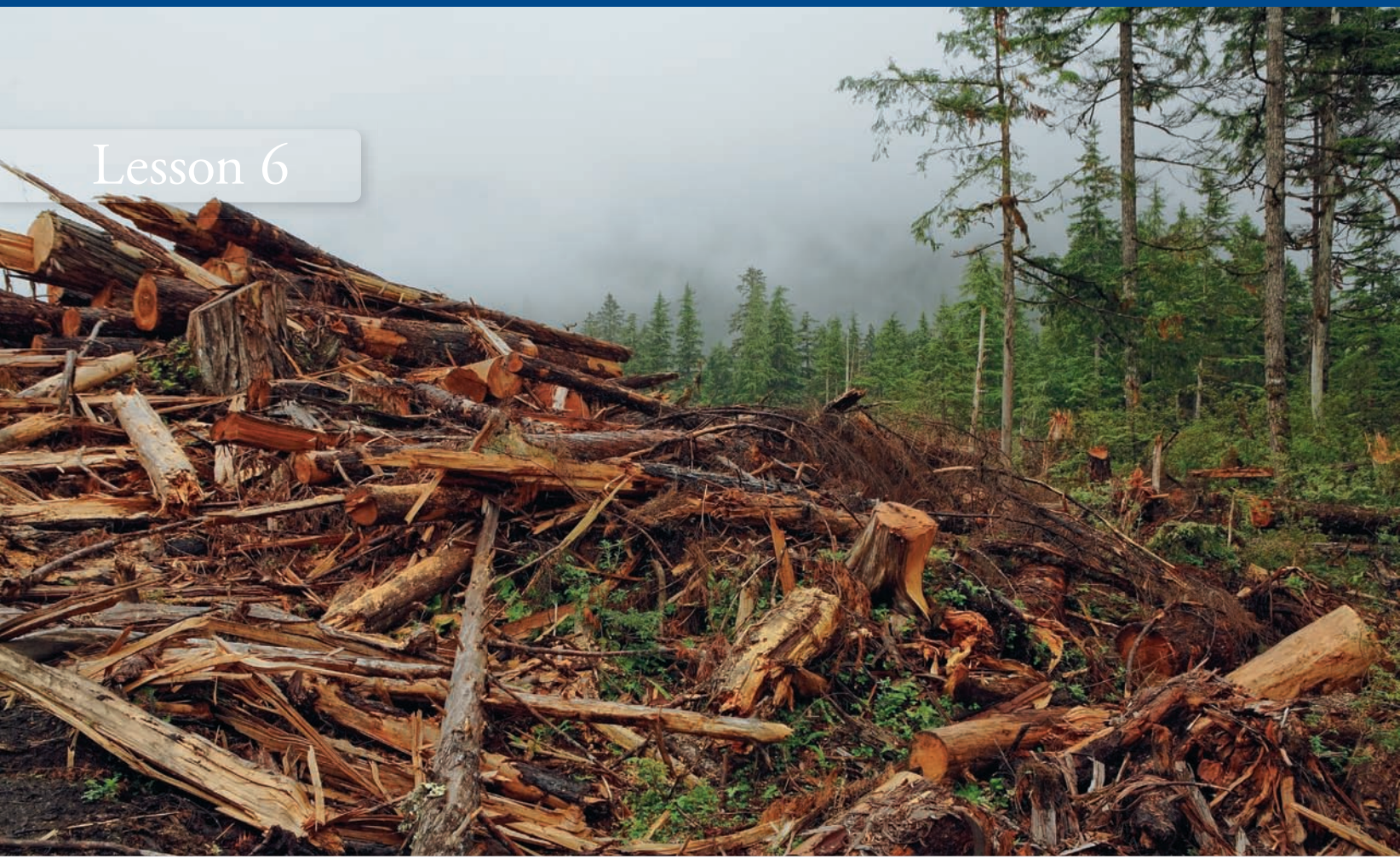
Lesson 6



Clear cut forest

Human Practices and the Transfer of Matter

Students review the influence of introduced species on the transfer of matter in chaparral and savanna biomes by summarizing the effects described in ***California Connections: A Tale of Feral Pigs***. Using two California case studies, they extend their learning to include two more biomes—temperate rainforest and desert—and they explore two additional human practices—forestry and agriculture.

In groups, students read a story about either the North Coastal Forests (Redwood) or the Salton Sea. They use the story to identify ways in which changes to these ecosystems might affect the transfer of matter through food webs. Students then form pairs and compare the two stories. They complete Venn diagrams illustrating similar effects of human practices in two different ecosystems.

Through class discussion, students apply the concepts of this lesson to the now familiar story of the introduction of feral pigs to chaparral and savanna biomes, enabling them to describe the similar consequences of human practices in different environments.

Background

The introduction of non-native species is just one of many human practices that affect the transfer of

Learning Objective

Describe the effects of human practices on the transfer of matter through natural systems (for example, the effects of agriculture and forestry on organisms with similar ecological roles are comparable in similar biomes).

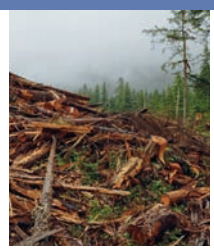
matter through natural systems. Certain forestry and agricultural practices have had similar effects.

Large-scale commercial logging began in the North Coastal Forests (Redwood) region of California shortly after the gold strikes of 1848 and 1850. The huge trees were prized for their timber, but by the 1910s, people became concerned about the loss of redwoods. Several conservation efforts succeeded in establishing redwood preserves; however, logging continued on privately owned land, increasing during the economic boom of the 1950s.

Logging can affect the flow of matter in redwood forests in many ways. For example, on a steep slope, clear-cutting—the harvesting of all trees in a stand at one time—leaves bare soil exposed to erosion. Soil erosion causes siltation in streams, changing the chemistry and physical characteristics of the aquatic habitat. This, in turn, affects the freshwater plants, macro invertebrates, fish, and other organisms that live there, as well as the animals that feed upon them.

The Salton Sea was formed in 1905 when spring flooding caused the Colorado River to break through an irrigation canal and overflow its banks. Since then, agricultural flows from the Imperial, Coachella, and Mexicali Valleys have maintained the sea. Until recently, the saline waters of the sea supported a thriving fishing industry of wrasse, halibut, corvina, and tilapia. The Salton Sea has also been designated a wildlife refuge due to its importance to migratory waterfowl and other birds.

Salton Sea



Irrigation practices that sustain desert agriculture affect the flow of energy and matter in Salton Sea food webs. Because less fresh water from the Colorado River has been entering the sea, its salinity has been increasing rapidly, affecting sensitive fish species. Along with the salts that flow into the sea with agricultural runoff come other minerals, pesticides, organic compounds, and toxins—all by-products of desert agricultural practices. This high flow of nutrients from agriculture has caused eutrophication (overgrowth of algae), deoxygenation, and fish kills.

Key Vocabulary

Irrigation: The act of supplying water to plants through pipes, ditches, or other means.

Logging: The act of cutting trees for lumber.

Phytoplankton: Tiny "plant" plankton that drift with currents in fresh or salt water. Phytoplankton make their own food through photosynthesis.

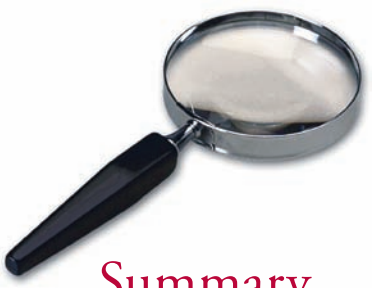
Salinity: The measure of the amount of salts dissolved in water.

Siltation: The buildup of silt as a result of having grains of soil washed into rivers and streams through erosion or deposited back on land during flooding.

Transfer of matter: The movement of nutrients from one organism to another through a food chain.

Zooplankton: Animal plankton that drift with currents in fresh or salt water.

Toolbox



Summary of Activities

Students read case studies about logging and agriculture in two California ecosystems They identify ways that changes to these ecosystems affect the transfer of matter through foods webs. Students then compare these two situations to the story of feral pigs.

Instructional Support

See Unit Resources, page 36

Prerequisite Knowledge

Students should have:

- completed previous lessons.

Advanced Preparation

Gather and prepare Activity Masters.

Gather and prepare Materials Needed.

Gather and prepare Visual Aids:

- Prepare transparencies.
- Post the wall map of California's **Natural Regions**.

Materials Needed

A-V equipment:
- Overhead or LCD projector, screen

Class supplies:
- Pencils

Unit Dictionary:
- Provided separately

Visual Aids

Transparencies:
- **Feral Pigs in the Food Web**, Visual Aid #25

Duration

Preparation Time
15 min.

Instructional Time
45 min.

Safety Notes

None

Activity Masters in the Supporting Materials (SM)

The North Coastal Forests (Redwood) Story
SM, Pages 75–76
One per student for half of the class

The Salton Sea Story
SM, Pages 77–78
One per student for half of the class

Redwood Forest Changes
SM, Page 79
One per student for half of the class

Salton Sea Changes
SM, Page 80
One per student for half of the class

Comparing Two Stories
SM, Page 81
One per student

Procedures

Vocabulary Development

Use the **Unit Dictionary** and the **Vocabulary Word Wall Cards** to introduce new words to students as appropriate. These documents are provided separately.

Step 1

Ask students to share what they remember about the influence of feral pigs on various organisms in savanna and chaparral food webs. Ask students to define the term, "transfer of matter." (*The movement of nutrients from one organism to another through food chains.*) Project the transparency **Feral Pigs in the Food Web** (Visual Aid #25) and ask, "What happened to the transfer of matter in this food web when feral pigs entered the scene? What organisms did they affect directly? What organisms were affected indirectly?" (*The feral pigs reduced the amount of plant matter in the system; they reduced the populations of lizards and quail; they influenced the decomposition of matter by disturbing the soil and eating worms and grubs; they may have reduced the flow of matter to other omnivores by eating their prey.*)

Step 2

Explain to students that, as in the chaparral, human practices have caused changes in North Coastal Forests (Redwood) and desert ecosystems. Using the wall map of Natural Regions, have a student point out the location of the North Coastal Forests (Redwood) and the Salton Sea.

Organize the class into groups of four and, dividing the two versions equally, give each group one of the two human influence stories: **The North Coastal Forests (Redwood) Story** (Lesson 6 Activity Master) or **The Salton Sea Story** (Lesson 6 Activity Master). Tell students that each story describes how a human activity influenced the transfer of matter in a natural system.

As you distribute the stories, also give each student a copy of the associated worksheet: **Redwood Forest Changes** (Lesson 6 Activity Master) or **Salton Sea Changes** (Lesson 6 Activity Master).

Step 3

Have students read the stories in their groups and work together to complete their worksheets. Each student should complete an individual worksheet.

Step 4

Pair one student who read about redwood forests with one student who read about the Salton Sea. Distribute copies of **Comparing Two Stories** (Lesson 6 Activity Master). Have the two students compare stories and worksheets. Ask students to take turns summarizing their story for their partner and then record the similarities and differences between the two case studies on **Comparing Two Stories.**

Step 5

When students think they have found all the similarities, bring the class back together and ask, "How does logging affect the transfer of matter in the redwood forest? (*Reducing coho fry populations and aquatic insect populations means less matter is transferred to their predators. Changes in matter available to their predators may lead to predators feeding more heavily on other organisms; the algae flowing to the insects may increase, with fewer insects feeding.*)

Step 6

Ask students, "How did agriculture and irrigation in and around the Salton Sea affect the transfer of matter in this ecosystem? (*Reducing worm populations means less matter transferred to their predators. Changes in matter available to their predators may lead to predators feeding more heavily on other organisms and may reduce the population size of these predators if not enough alternative prey is available. Migratory birds using the Salton Sea as a stopover may not get sufficient food and have to adjust their routes and may be more vulnerable to predation because they have less food and are not as healthy.*)

Step 7

Ask students:

- How do these examples connect to the story of feral pigs in California and Australia? (*The human activity or change affected some populations directly, and then these changes affect other populations indirectly. The changes had similar influences on the same ecological roles, even in very different biomes.*)
- What do these stories show us about humans and biomes? (*We can see direct and indirect effects of human activities in any biome. Matter flows through all food webs in all biomes in similar ways, so the influences of human activities on food webs have some similarities, regardless of the organisms involved, or which biome is being considered.*)

Lesson Assessment

Description

This lesson teaches students that human practices influence the flow of matter through food webs in natural systems. Students read a case study about human activities in either California's desert or redwood forest. In Step 3, students demonstrate that they can describe the influence of logging or agriculture on the flow of matter through the ecosystems. **Comparing Two Stories** (Lesson 6 Activity Master), completed in Step 4, assesses whether students understand the lesson concepts and can apply them in two different biomes. The final class discussion can be used to informally asess whether students can recognize the lesson concepts in a new situation.

Suggested Scoring

Score the **Redwood Forest Changes** (Lesson 6 Activity Master) and **Salton Sea Changes** (Lesson 6 Activity Master) by awarding 10 points for a complete and accurate diagram. Subtract one point for each incorrect answer. Score **Comparing Two Stories** by awarding one point for each correct statement, up to a maximum of 6 points.

Answer Key and Sample Answers

Redwood Forest Changes

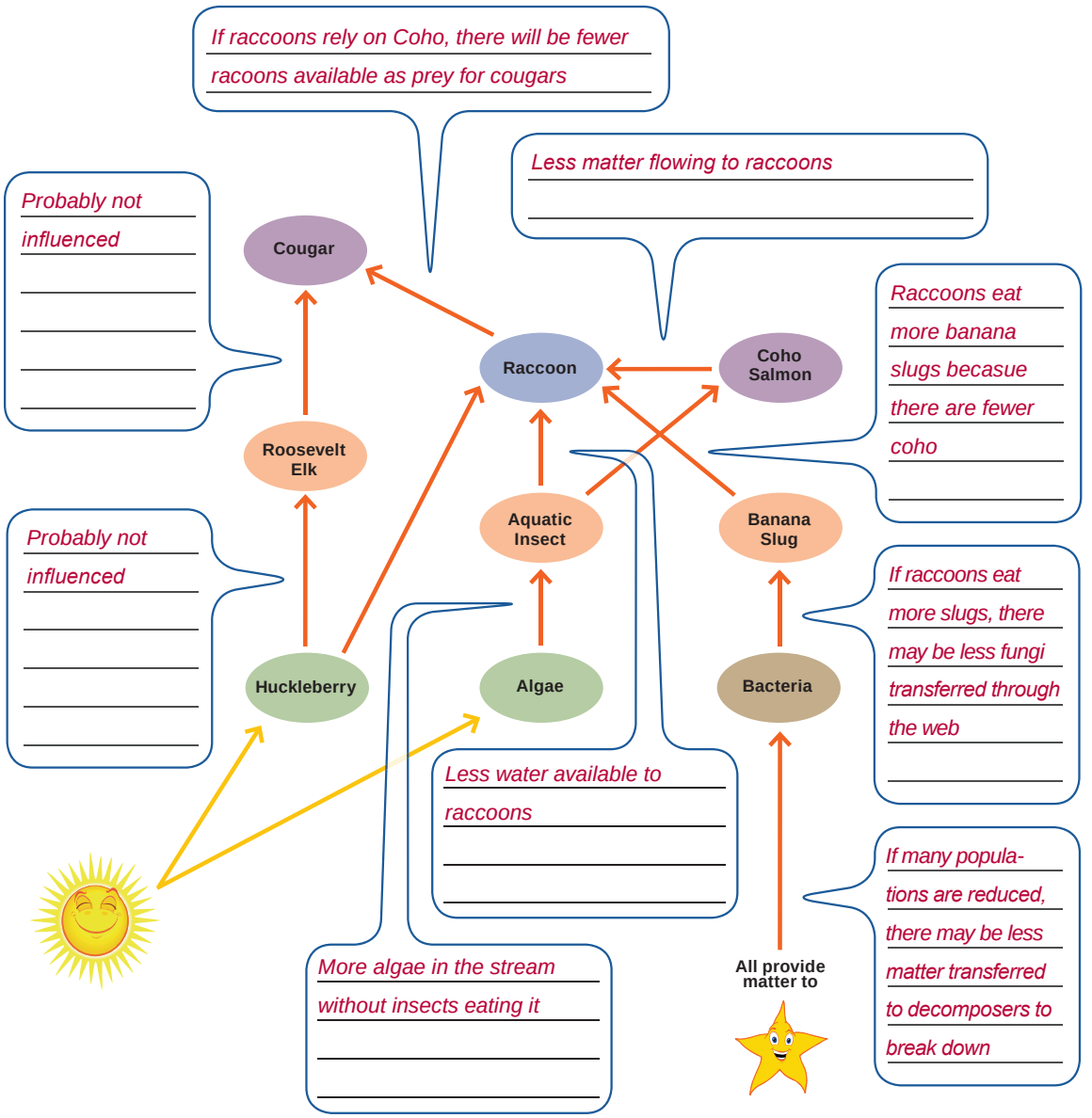
Lesson 6 Activity Master

Name: _____

How Does Logging Affect Food Webs in California's Redwood Forests?

The story described how logging affects the number of coho salmon in a stream. It also said that silt affects aquatic insects which coho salmon eat.

When the number of one species in an ecosystem changes, others often change. What would happen if there are fewer aquatic insects? What would happen if there are fewer coho salmon? How would this affect the flow of matter in this natural system? In the blanks next to the arrows, describe how the flow of matter may change if there are fewer aquatic insects or coho salmon.



Salton Sea Changes

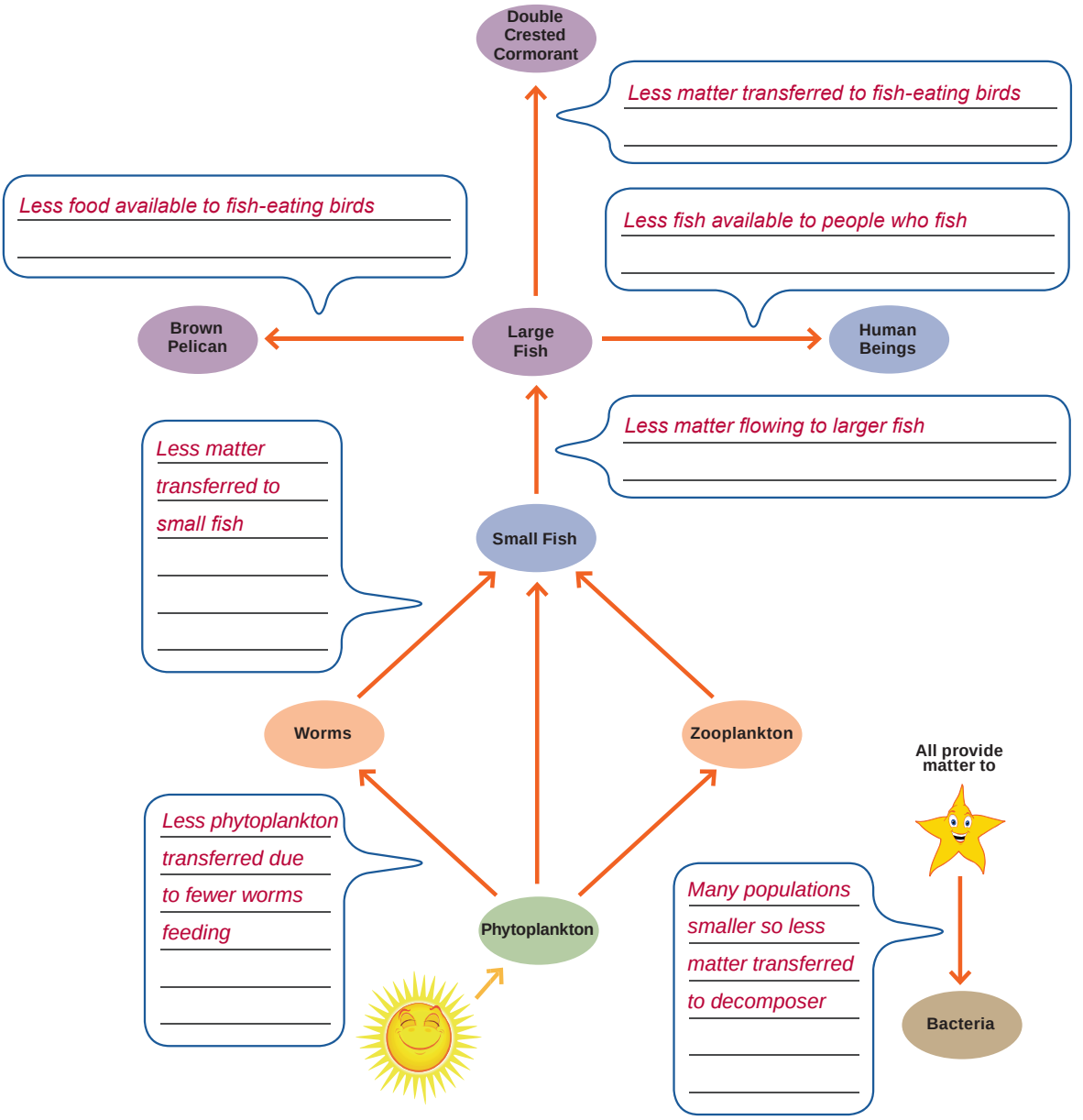
Lesson 6 Activity Master

Name: _____

How Have Agriculture and Irrigation Affected Food Webs in California's Salton Sea Desert Ecosystem?

The story you read described how farming affects the amounts of nutrients and salinity in the Salton Sea. Scientists are concerned that high salinity will hurt plants and animals in the Sea.

Many organisms higher in the food web rely on worms that eat phytoplankton. If the salt level gets too high for worms and very, few will live. How would this affect the flow of matter in this natural system? In the blanks next to the arrows, describe how the flow of matter may change if there are fewer worms.



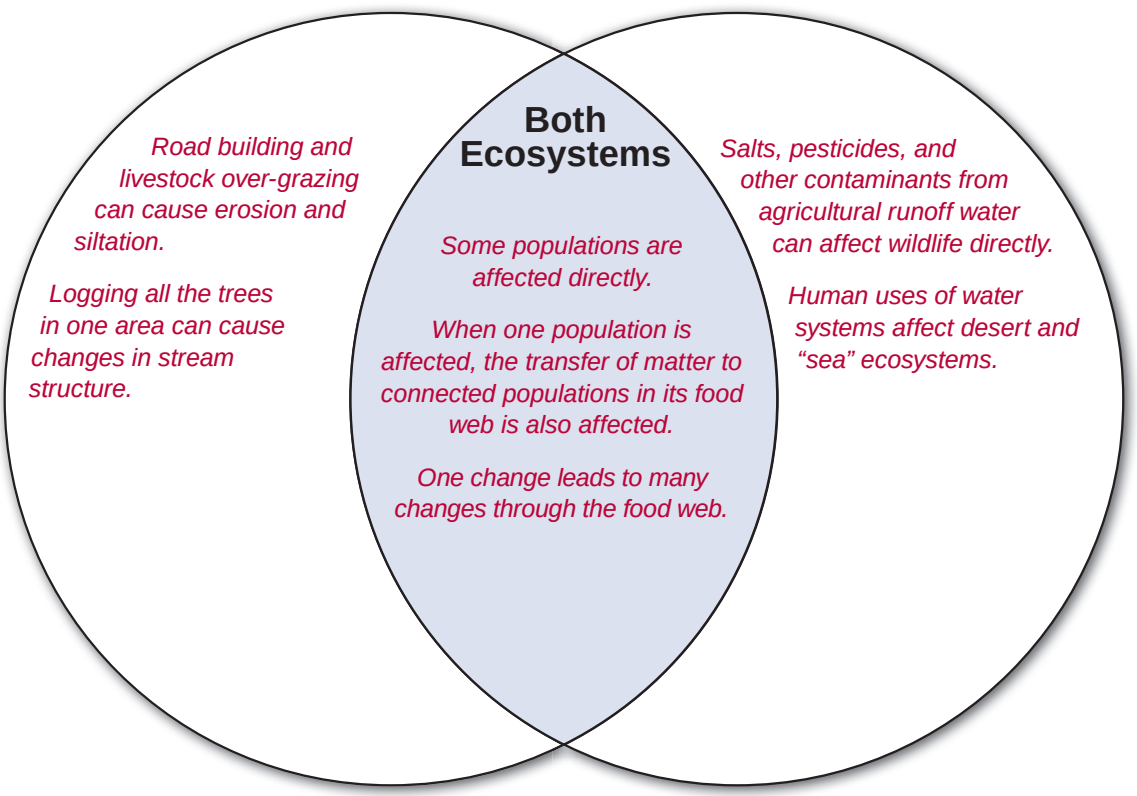
Answer Key and Sample Answers

Comparing Two Stories

Lesson 6 Activity Master

Name: _____

Compare the effects of human activities in the redwood forest and Salton Sea ecosystems. List at least two effects in each section of the diagram. List effects that are found in both ecosystems in the center section where the circles overlap.



The North Coastal Forests (Redwood) Story

From San Francisco to the Oregon border, the California Fish and Game Commission has listed coho salmon as "endangered." Why? Let's look at some human practices that may have affected them.

Adult coho salmon leave the ocean and enter freshwater streams in California's North Coastal Forests (Redwood) to lay their eggs, or spawn. They spawn between September and January in small, shallow streams with gravel bottoms. The females dig gravel nests and lay thousands of eggs in them. Once the eggs hatch, the young fish, or fry, emerge from the gravel. They live in the streams for two to three years before going to sea.

These young coho salmon rely on the clear pools in these streams as their habitat. Shaded by towering redwoods, the water remains cool even in the summer. Rocks, fallen stumps, and overhanging plants create hiding places that help these fish avoid predators and find food. Young coho salmon and other fish fry feed on insects, spiders, and small aquatic animals.

Coho salmon

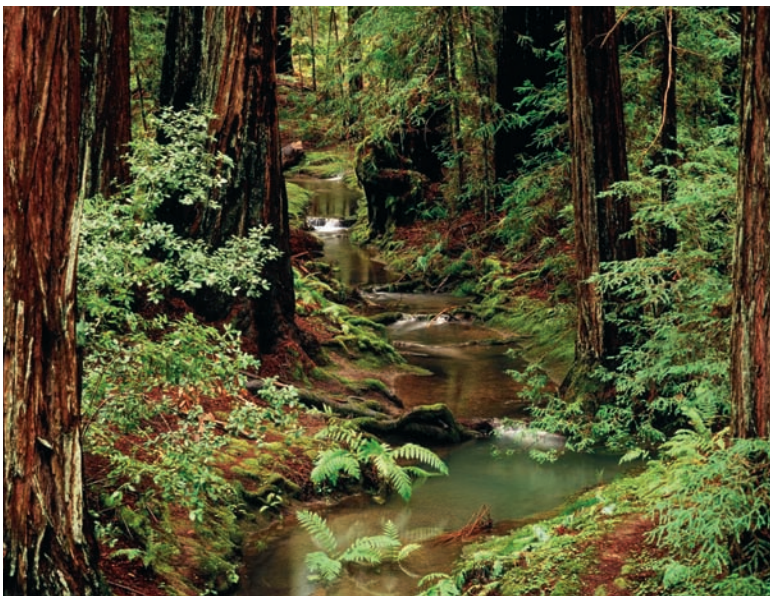
Some human practices have made these redwood forest streams less healthy for coho salmon. Scientists believe these human practices are the main reason coho salmon are endangered. For example, certain logging practices can change stream systems. Logging means to cut trees for lumber.

Sometimes, all of the trees on a hillside are logged at the same time, exposing the soil and causing silt to wash down into streams. Silt is composed of fine grains of soil. Siltation occurs when the silt builds up in rivers or streams. The silt clouds the gravel beds, killing salmon eggs and young fry. Removing trees along streams

Logged area

causes more siltation and takes away the hiding places of fish. Logging all the trees in one area can also increase the amount of sunlight that reaches the stream. The water temperature rises, becoming too hot for the young fish.

Logging and other human practices have caused Northern California's coho salmon population to drop 70 percent since 1960. Poor stream quality has affected the plants and animals that live there. When the numbers of salmon and other stream fish species drop, their predators have less to eat. Less matter is transferred to their predators. If coho predators have less to eat, their numbers may drop also. Less matter will be transferred to the animals that eat them. As a result, the transfer of matter through the whole coastal redwood forest ecosystem can be altered.



Redwood forest

The Salton Sea Story

The Salton Sea is in Southern California's Colorado Desert. It formed between 1905 and 1907 when the Colorado River flooded and broke through an irrigation canal. People had made the canal to bring water to farms.

Even though the Salton Sea was created by human activities, it has become an important ecosystem. Most of the land around the Salton Sea is agricultural. At the northern end of the sea is a recreation area. Many visitors come to the Salton Sea for bird watching, camping, and boating. The sea has been stocked with game fish for people to catch. The fish also provide food for huge numbers of waterfowl that fly over the sea during their migrations. The southern end of the sea is a wildlife refuge.

Because the Colorado Desert is very dry, water habitats like the Salton Sea are important to wildlife. However, human practices related to agriculture, recreation, and irrigation have harmed the sea. Streams have been dammed, and the water has been sent to farms and cities. Little fresh water flows into the sea. Instead, salts, pesticides, and other chemicals drain into the sea from farm fields. Fish and waterfowl take in these chemicals. When birds of prey eat the fish, the chemicals pass into them. Pollution and changes to oxygen levels have caused many fish and birds to die.

Salton Sea

Because the Salton Sea receives so little fresh water, its salinity is increasing. This means the water is getting more salty. Scientists are concerned that it may soon become too salty for the fish and other organisms living in it. This change will affect the transfer of matter in the Salton Sea food webs.

The Salton Sea food webs are supported by tiny drifting plants called phytoplankton that use the Sun's energy to make food. The phytoplankton are eaten by zooplankton (tiny drifting

Pelican fishing

animals) and worms. Small fish eat the worms and zooplankton. Larger fish eat the small fish. Birds such as pelicans, cormorants, and osprey eat the larger fish.

Scientists do not know which organisms will be affected first by the increased salinity. They also do not know how those changes will influence other species. They do know that changes to one species in a food web will cause changes for both the animals it eats and the animals that eat it. In other words, the transfer of matter between a species and its prey and predators will change. For example, if the number of worms at the base of the food web decreases, less food would be available to the small fish that eat the worms. This could result in a decrease in the number of small fish. Fewer small fish would mean that less food is available to larger fish. As a result of one change, the transfer of matter through the whole Salton Sea ecosystem could be altered.

Palm trees in Salton Sea

Feral Pigs in the Food Web